



AIR NAVIGATION SERVICES
OF SWEDEN

Investigating the Safety-Relevance of Limited Distinctive Features on a Multi Remote Tower-Working Position

Lothar Meyer and Hartmut Fricke

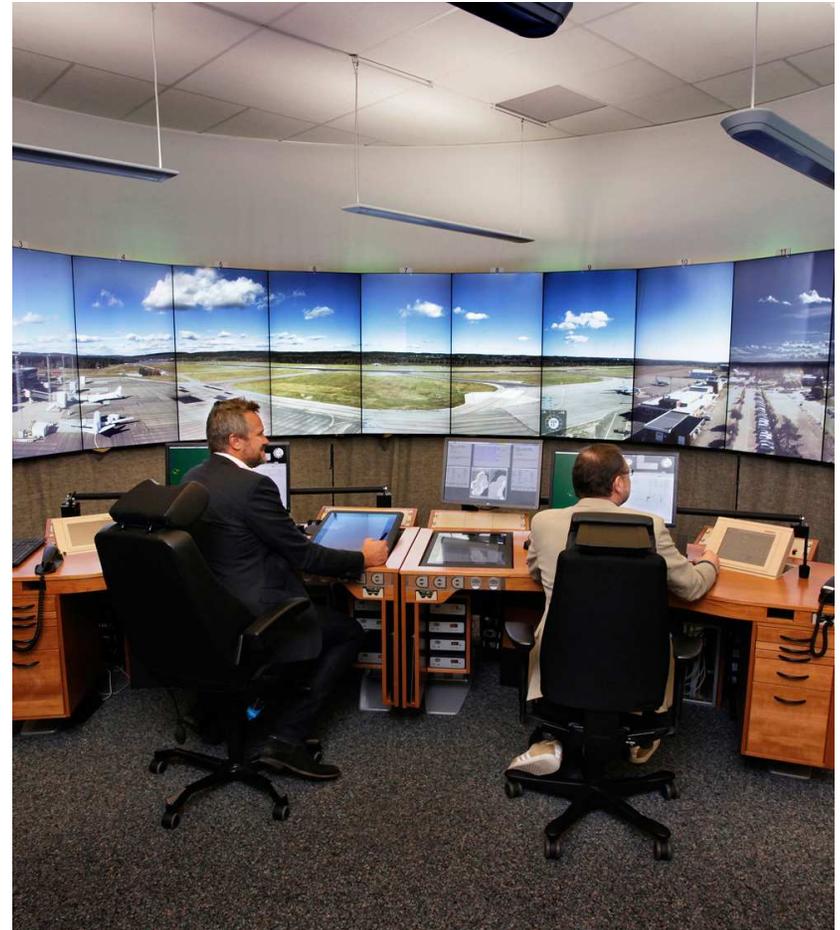
Presented by Lothar Meyer

6TH SESAR INNOVATION DAYS

9 November 2016, Delft

Remote Tower

- ✓ Single Remote Tower is operating
 - Airport Örnköldsvik
 - Airport Sundsvall (from tomorrow on!)
- ✓ Operational experience available for Single Remote Tower
 - Operational benefits
 - Social working environment
- ✓ All problems seem solvable (technique/ human/ procedures)
- ✓ A challenge is still to approve the system



Multi Remote Tower

- ✓ Controlling at least two airports by one tower controller at a time
 - Independent
 - Low traffic volume
- ✓ The next step for increasing the effectiveness of Remote Tower
- ✓ Experience available from experimental and field studies in the scope of SESAR 6.9.3
- ✓ Increasing
 - cost-effectiveness of low density airports
 - work load

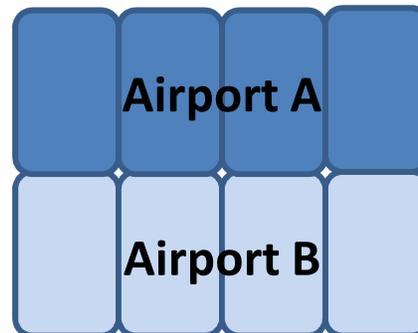


Visual Presentation

Horizontal
Layout



Vertical
Layout



Triangle
Layout



SESAR 6.9.3 D32

Coping with Human Implications

- ✓ Three functions that are introduced by a Multi Remote Tower
 - Switching (attentional refocusing)
 - Merging/Opening an airport
 - Splitting up an airport (i.e. hand-over to another Remote Tower module)
- ✓ New hazards may result when functions are used inappropriately in a situation
- ✓ SESAR 6.9.3 (HP Assessment report D28) identified
 - supervisory errors and
 - confusion errors
 - etc



Lesson Learned from Flight Deck-Safety

- ✓ Safety-relevant effects of complexity resulting from the functionality and assistance of automation
- ✓ Example Accident of TransAsia Airways flight GE235 from Taipei to Kinmen Island in 2015
 - shut down the wrong engine
 - the “misinterpretation of the pattern of data (cues) available” might have been caused by “similarity of cue patterns between malfunctions with very different sources”



Sources of Confusion

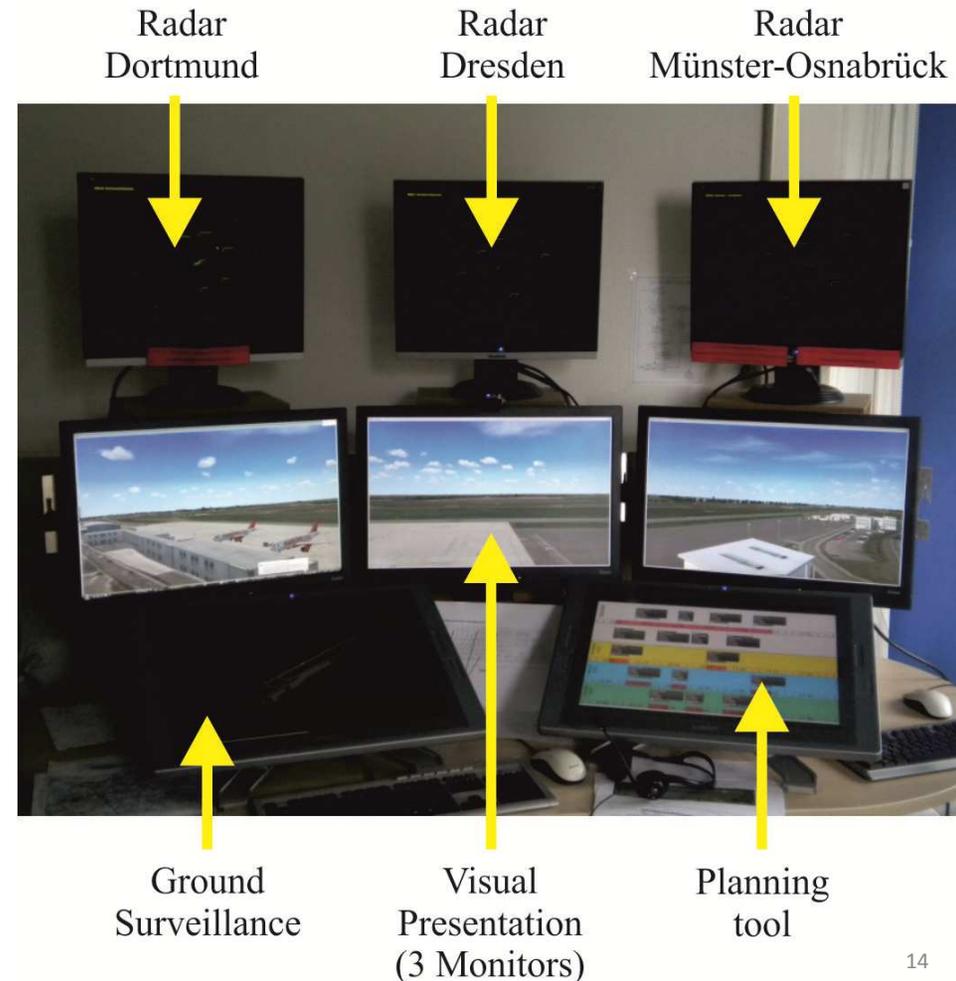
- ✓ Misattribution of the human memory causes confusion about the origins of retrieved information (Schacter & Wiseman, 2006)
- ✓ Similarity of information cues such as
 - taxiways designators,
 - aerodrome weather information (QNH, wind direction, strength),
 - reporting points,
 - operational agreements and
 - navigational aid and orientation (mountains, lakes, sea)
- ✓ Distinctive features are needed that support the human to encode and to associate the cues to the respective airport

Experimental Study

- ✓ Investigating the effects of limited distinctive features
 - ✓ First conceptual study shall identify the relevance of
forgetting and confusion
 - ✓ Common cause in “lapses in memory”
 - ✓ Slight knowledge available, which activities are most affected
 - ✓ Open investigation
 - Identifying the affected activities of the ATCO
 - Identifying potential risk hot spots in the concept
- Experimental-aided hazard identification**
- Gathering findings for further investigation (hypothesis development)

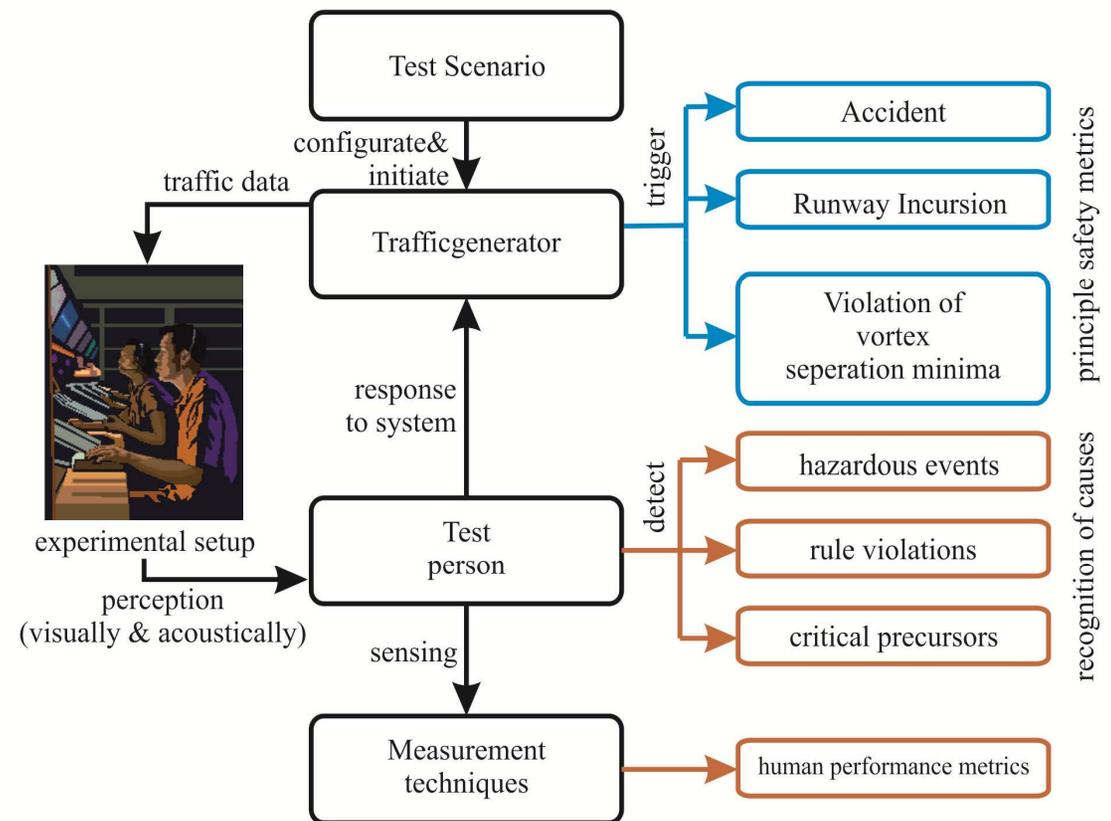
Experimental Setup

- ✓ Cooperation with TU Berlin and TU Darmstadt
- ✓ 5 ATCOs from the DFS
- ✓ 1 Hour and 20 minutes per trial with 3 pseudo-pilots (PPL licensed)
- ✓ 3 airports at a time
 - Dresden,
 - Dortmund and
 - Münster-Osnabrück
- ✓ 3 VFR movements (Cessna C172SP Skyhawk)
- ✓ Using one microphone (joined tower freq.)
- ✓ Traffic pattern included taxiing, take-off, crossing the control zone and landing.



Stress Testing Procedure

- ✓ Hazard induction for increasing uncertainty in operations
- ✓ ATCOs are instructed to recognize hazards and to report them instantly
- ✓ Induced uncertainty shall force the ATCOs to deviate from routine operations (increasing stress)
- ✓ Increasing awareness of the ATCOs for conceptual weaknesses
- ✓ Stimulating confusion and forgetting



Stress Testing Procedure

	Hazard
1.	Animal a
2.	Unautho by grou
3.	Sever w
4.	Unautho zone by

Source: Me



Data Analysis

- ✓ Objective Data
 - Video and audio recordings from a video camera
 - Audio from voice communication
 - Key-stroke logs, logging switch events
 - Hazard detection
- ✓ Ex-post interviews
 - Closed-end questions for
 - reasoning the failed detection of hazards
 - information cues
 - Open interview for revealing weak points in the concept



Hazard Detection

- ✓ 14 hazard events were detected out of 20
- ✓ Hazards not detected
 - 4 of 5 not detected “Unauthorized entry of control zone by aircraft”
 - One of 5 “Unauthorized entry of runway by ground vehicle
 - One of 5 “sever weather”
- ✓ 3 of 14 hazard events could not be associated to the respective airport of hazard occurrence
- ✓ ATCOs argued that the design of the experimental setup influenced the probability of detecting the hazards

Detecting Confusion

- ✓ Identifying non-nominal behaviour (plausibility checks)
 - actual operational demands mismatches the selected airport
 - misunderstanding and mismatch in the expected advises and clearances
- ✓ Confusion of
 - one waypoint designator and
 - one airport selection
- ✓ Confirmation of the confusion by the respective ATCO during the open interview
- ✓ Difficulties of detecting confusion that is immediately recovered by the ATCO

Open Ex-Post Interviews

- ✓ Statements concerning the hazard “Unauthorized entry of control zone by aircraft”
 - “the borders of the control zones are poorly monitored”
 - “I completely hid them from my perceptual area”
- ✓ Poor sharing of attention between the airports
- ✓ ATCOs stated that confusion is probable for
 - ATIS- Information (QNH, wind direction and speed, aerodrome circuit)
 - designators of taxiways to and from the runway

Conclusion

- ✓ Confusion hazards could be observed and can be regarded as concept-related
 - Designators are too similar (ICAO conformity)
 - Poor management of attention
- ✓ ATCOs stated that safety-relevant operational information might mix up
 - False altimeter setting -> Accident Risk (ref. NTSB SEA03FA028)
- ✓ Forgetting could not be concluded
- ✓ Poor management of attention
 - Visual scanning pattern
 - Switching and refocusing the attention between the airports

Adjusting Attention and Distinctiveness

- ✓ Need for management of
 - information perception
 - attentional resources of the ATCO
- ✓ Means of management
 - avoiding the fragmentation of working pattern – planning traffic flow allows for establishing a harmonised order of actions and for setting the focus on one airport
 - adding additional features for distinguishing information (colour coding, font types, distance information)
 - adding a relaxation time after switching the airport

Further of Investigation

✓ Risk Analysis

- Design-related question: is the potential for confusion relevant for us?
- Does the hazard have a relevant impact on operations?
- Eye-Tracking for identifying indicators of confusion
- Situational Awareness testing allows for comparing the potential for confusion concerning single information cues



Thank you

Lothar Meyer

lothar.meyer@lfv.se

Hartmut Fricke

fricke@ifl.tu-dresden.de